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November 7, 1966

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ATOMIC ENERGY COMMISSION

311152

BERYLLIUM DEVELOPMENT AND PRODUCTION WORK AT AEC SITES

CLASSIFICATION CANCELLED. OR ~~CHANGED~~ TO with deletions BY AUTHORITY OF J. Deniogalli, OC, DOE BY memo DATE 5/10/00

Note by the Secretary

The General Manager has requested that the attached memorandum of November 1, 1966, from the Director, Office of Economic Impact and Conversion, with attachments, be circulated for the information of the Commission.

W. B. McCool

Secretary

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[redacted] 1135-5575-15-1

OPTIONAL FORM NO. 10
MAY 1962 EDITION
GSA FPMR (41 CFR) 101-11.6

UNITED STATES GOVERNMENT

Memorandum

TO : R. E. Hollingsworth
General Manager

DATE: November 1, 1966

THRU : J. A. Erlewine, AGMO

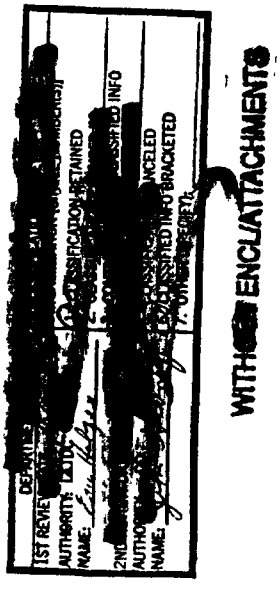
FROM : John C. Ryan, Director
Office of Economic Impact ~~and Conversion~~

SUBJECT: BERYLLIUM DEVELOPMENT AND PRODUCTION WORK AT AEC SITES

The following is a preliminary report covering information received to date in response to our October 21 request for information on all AEC beryllium development and production work.

The Managers of Chicago, Idaho, Nevada, Richland, and Savannah River Operations Offices report no such work being carried on or contemplated. Richland indicates, however, continuous attempts to develop strong industrial competition and more economical processes for beryllium alloy braze rings; and Savannah River reports testing beryllium, along with several other metals, for specific weapons applications.

Oak Ridge supplied information by teletype concerning Y-12 development work on the XW-68 programs and subsequently furnished a more comprehensive statement of all Y-12 beryllium work. These are attached at Tabs A and B.



Although we do not have a full reply from ALO yet, we do have a summary of the October 20, 1966 Sandia Corporation meeting with the beryllium industry. This is in the form of a letter dated October 24, 1966 from Mr. C. F. Bild and is at Tab C. A summary prepared by DMA covering its current knowledge of beryllium work within the weapons complex is at Tab D. The summary of the October 20 Sandia Corporation meeting indicates that meeting to have been highly successful and may be of interest to the Commission.

At our suggestion, Oak Ridge Operations and Y-12 are currently developing plans for a meeting to be held in four to six weeks, similar to that held by Sandia. The agenda and related plans will be forwarded to us shortly. Lockheed has also been pressing Y-12 for details of its gas-pressure bonding techniques. It is hoped to develop an agenda sufficiently broad so that all interested parties can be accommodated at the same meeting.

Oak Ridge is also furnishing us with copies of a recent exchange of correspondence between Y-12 and Lockheed, in response to their interest in placing additional beryllium development work at Oak Ridge. When the above-mentioned material, and the balance of the information in response to our October 21 request is received, we will forward a final summary.

Attachments:
As stated above

[redacted]

COPY

OCTOBER 21, 1966

FROM: S. R. SAPIRIE, USAEC, OAK RIDGE, TENNESSEE

TO : E. J. BLOCH, USAEC, WASHINGTON, D. C.

FOLLOWING IS A SUMMARY OF THE WORK BEING PERFORMED AT Y-12 TO DEVELOP A PROCESS FOR THE PRODUCTION OF BERYLLIUM COMPONENTS FOR THE XW-68 PROGRAM. THIS WORK IS BEING PERFORMED AT THE REQUEST OF SANDIA CORPORATION, LIVERMORE, AND IS BEING FUNDED UNDER SANDIA PURCHASE ORDER NO. 92-2729 IN THE AMOUNT OF $75,000 AND FROM Y-12 PROGRAM 03 PROCESS DEVELOPMENT FUNDS, APPROXIMATELY $75,000.

THE PROCESS BEING INVESTIGATED AT Y-12 FOR PRODUCTION OF THESE COMPONENTS INVOLVES COLD ISOSTATIC PRESSING OF COMMERCIAL BERYLLIUM POWDER INTO GREEN COMPACTS FOLLOWED BY GAS-PRESSURE BONDING OF THE GREEN COMPACTS. THIS DEVELOPMENT PROGRAM IS BEING CONDUCTED IN TWO PHASES, AND PHASE I INVOLVES PRODUCTION OF SMALL SCALE COMPACTS AND INCLUDES THE FOLLOWING TASKS:

1. PROCUREMENT OF COMMERCIALLY AVAILABLE BERYLLIUM POWDERS AND A DETERMINATION OF THE CHARACTERISTICS OF THESE POWDERS.
2. COLD ISOSTATIC PRESSING OF THE POWDER INTO ACCEPTABLE GREEN COMPACTS UTILIZING Y-12 PRESSURE VESSELS.
3. GAS PRESSURE BONDING OF THE GREEN COMPACTS INTO RIGHT CYLINDERS AND HOLLOW RIGHT CONES UTILIZING THE Y-12 GAS AUTOCLAVE FACILITY.

THE OBJECTIVE OF PHASE II OF THE PROGRAM IS TO DEMONSTRATE BY DECEMBER 1, 1966, THE TECHNICAL AND ECONOMIC FEASIBILITY OF GAS-PRESSURE BONDING FULL-SCALE THIN-WALL BLANKS SUITABLE FOR MACHINING. IN THIS PHASE OF THE WORK THREE FULL-SCALE BLANKS ARE TO BE PRODUCED.

[redacted]

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CO[redacted]TIAL
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OPTIONAL FORM NO. 10
MAY 1962 EDITION
GSA GEN. REG. NO. 27
5010-107

UNITED STATES GOVERNMENT

Memorandum

TO : John C. Ryan, Director, Office of Economic Impact and Conversion, HQ

DATE: October 28, 1966

FROM : S. R. Sapirie, Manager, Oak Ridge Operations

SUBJECT: BERYLLIUM DEVELOPMENT AND PRODUCTION WORK

OPO:HDH

Reference is made to your teletype dated October 21, 1966, requesting information concerning the above subject.

At the present time the Y-12 Plant is not performing any beryllium development or production work for other Government agencies and no such work is contemplated in the future. Except for a small development effort in connection with the SNAP-27 program, all Y-12 beryllium work is associated with the AEC's weapons program. The work being conducted for Sandia Corporation, Livermore, on the investigation of techniques for production of beryllium components for the MK-3 Re-Entry Vehicle was summarized in our teletype of October 21, 1966, to E. J. Bloch, a copy of which was furnished you. The other beryllium development work currently being conducted at Y-12 is summarized below as follows:

SNAP-27 Program

The Y-12 beryllium development work in support of the SNAP-27 Program was initiated in September 1965 at the request of the New York Operations Office. The work was originally authorized to extend for a period of six months at a cost of $119,000. In March of 1966, New York Operations Office authorized an increase in the program to a total of $311,731.

The objective of this development program is to determine the feasibility of using beryllium as a material of construction for components of the SNAP-27 Radioisotope Thermoelectric Generator. Prior work on this program has included selection of materials and the development of processes for fabrication, joining, assembly and inspection of components. Current work is limited to the development of joining and testing techniques.

The costs incurred at Y-12 through September 1966 on this development program amounted to $279,872. It is expected that this work will be completed by February 1967, and no further work is contemplated at Y-12.

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or the [redacted]
an unauthorized person is prohibited.

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XW-62 Program

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This possible future application for beryllium was discussed by Mr. R. F. Hibbs, Y-12 Plant Superintendent, during the Beryllium Meeting held at Rocky Flats in June 1966.

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The costs which have been incurred to date on this development effort are estimated at $250,000.

Diffusion Bonding

Deleted

It is estimated that this project will be completed by January 1, 1967.

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The rough blanks required for diffusion bonding work are procured from commercial sources.

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The current Y-12 beryllium production work is limited to finish machining of weapon components from blanks and rod stock which are procured from

industry. The specific weapons programs involved are the MK-55 and MK-56 which are presently scheduled to be in production through FY 1968.

With regard to your question concerning the placement of beryllium development work with industry, we offer the following comments:

1. Industry does not have the capability to perform the majority of the beryllium work undertaken at Y-12, and it would not be economically feasible for the AEC to establish the required capabilities in industry. For example, the Y-12 development work for Sandia on the MK-3 Re-Entry Vehicle requires the use of the equipment and facilities which would require the expenditure of several millions of dollars to duplicate in industry (i.e., isostatic pressure vessels and gas autoclaves).

2. A sizeable portion of the Y-12 beryllium development work is the type of work which has also been performed in-house and industry has never indicated an interest in. Examples of this type work are in the areas of machining and joining.

3. Time scales and frequent design and specification changes preclude the offering of any significant amount of beryllium development work to industry.

4. The Y-12 development program on wrought beryllium was based on United Kingdom proprietary information and for this reason could not be placed in industry.

5. Many of the Y-12 beryllium development projects are undertaken at the request of the weapon design laboratories. In these cases we assume that the design laboratories have determined that the work should be performed in-house.

6. Our knowledge of beryllium development contracts which other Government agencies have sponsored indicates that the return per dollar invested was very minimum.

You will recall that the question of performing beryllium development work in-house versus placing the work in industry was reviewed by the Beryllium Processing and Capability Study Group and is covered in their report.

Please advise if we can be of further assistance to you in this matter.

for S. R. Sapirie

SANDIA CORPORATION
Sandia Base, Albuquerque, N. M.

October 24, 1966

C. F. Bild
Director of Materials
and Process Development

Mr. D. Johnstone, Assistant Manager
Office of Plans and Budgets
Albuquerque Operations Office, USAEC
P. O. Box 5400
Albuquerque, New Mexico

Re: Meeting with Beryllium Industry on October 20, 1966

A meeting was held October 20, 1966 at Sandia Corporation, Albuquerque Laboratory on the subject of the beryllium R&D program currently underway at both the Albuquerque and Livermore laboratories. Present at the meeting were representatives of the four industrial beryllium companies. The following personnel participated in the meeting:

G. S. Mikalapov	Brush Beryllium Company
W. Greenleaf	Beryllium Metals & Chemical Co.
E. Smith	The Beryllium Corporation
J. Denny	The Beryllium Corporation
W. Lidman	General Astrometals Corp.
L. M. Berry	Sandia Corporation (1130)
D. R. Adolphson	Sandia Corporation (1131)
J. L. Ledman	Sandia Corporation (1131)
C. H. Maak	Sandia Corporation (1131)
L. M. Lee	Sandia Corporation (1114)
M. W. Mote	Sandia, Livermore (8134)

The general atmosphere of the meeting was established by informing the non-AEC personnel that we have periodic meetings of this type between Livermore and Albuquerque personnel when there are R&D programs of mutual interest. Such a mutual interest exists in beryllium technology and it is very important that we are kept advised of the status of each other's programs. The meetings are very informal and are considered "working" meetings where comments, opinions and reactions to each other's work are encouraged.

We then proceeded to go into the R&D programs applicable to this area. The following R&D programs were discussed in detail:

Section I - Fabrication

Isostatic hot pressing of Be at Y-12 (Mote)
Shear forming and roll extrusion of Be at NIW (Maak)

Section II - Toughness

Fracture Tougheness of Be (Ledman)
Flow and Fracture of Be (Maak)
Spallation of Be (Lee)

Section III - Advanced Studies

Ultra high pressure effects on Be (Maak)
Surface Modification of Be by ion bombardment (Ledman)

There was, quite naturally, considerable discussion of the Y-12 isostatic pressing work. They asked many questions relative to processing details. Mr. Mote made the group aware that there were certain aspects of the equipment at Y-12 he could not discuss because he had been advised that these details were of a patentable nature and that Y-12 desired to protect the knowledge until the patents had been filed. In general, Mr. Mikhalapov was interested in beryllium process information and not weapon information. The meeting could have been held on an unclassified basis without having created a processing communications barrier. He was advised that we could not see any reasons for this knowledge to be withheld (once any patentable aspects were taken care of). The industrial concerns who were interested would need to approach Y-12 or the AEC directly and make their needs known. Mr. Mikhalapov expressed the viewpoint (seconded by Mr. Smith of the Beryllium Corporation) that they were concerned about the possibility of successful development of hot isostatic pressing at Y-12, and that this technology would be utilized in the production of product. Thus, the industry would be behind in the technology and production would thus be accomplished at Y-12. He expressed the very strong desire to be kept fully informed of the technology developments at Y-12. He was fully aware, however, that this request could not be granted by anyone in our meeting and that the industry would have to take additional steps to achieve this request. He expressed the very sincere appreciation of being invited to our meeting so he could hear first hand the nature and extent of our programs, the status of the work, and our future plans. This expression was strongly seconded by the other companies represented.

The industrial people present, although aware of shear forming were not aware that Be had been shear formed. They were quite interested in the roll-extrusion process as described by Mr. Maak. They initially got the impression our only interest was in finding a way to shape wrought ingot Be. This initial mis-impression was clarified by discussions of the various sources of preforms, (cast, forged ingot, forged powder, machined VHP powder). They were aware of the utilization of S-200 machined rings as inserts in the isostatic pressings being developed at Y-12. Consequently they were impressed by the capability of roll extrusion, to put internal contours on conical shapes.

The section on toughness determination went very well. They seemed to have made up their minds that Be was brittle and one must live with it and design around it; and that there were no toughness tests which could be applied to this material that had any great deal of merit. The presentation of the three areas of toughness (crack propagation, flow and fracture, and spallation) which we are working on and which are showing up reproducible differences in toughness of various grades of Be was very well received. They repeatedly said "Why didn't you people start doing this 10 years ago?" We advised them that we would keep them informed on the progress in these areas by sending them the data as it was generated.

The advanced studies of ultra-high pressure and surface modification were actively discussed. We were pleased about their active participation in the discussions of the pros and cons of this advanced work. It most certainly was typical of the informal "working" type of meeting we were wanting to have. In summary, we believe the following observations are valid:

(1) The industry was very pleased to be invited to our meeting because they could learn from first hand sources the status of the beryllium R&D effort at an AEC design agency.

(2) The industry was impressed by the breadth and depth of our program and by the vigor we are showing in its execution.

(3) The industry left with the feeling that they know our people and our total Be program and that there is no activity we are withholding from them relative to beryllium technology.

We believe the meeting went off very well. All of the visitors expressed a desire to be invited to future meetings and to be kept informed of the progress we are making in our programs. They were advised that it is our desire to remain informed of their activities and it was agreed that this would be accomplished at a future meeting.

Y-12 PROJECTS

Diffusion Bonding of Beryllium

Deleted

Electron Beam Welding of Cast and Wrought Beryllium

Deleted

Refinement of welding techniques for welding case and fins for SNAP-27.

Brazing Al to Be

Deleted

Gas Tungsten-Arc Weld of Be

Deleted

Bi-Metallic Bonding Be-U

Project to establish process for joining uranium and beryllium and evaluation of physical properties of the joint.

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Beryllium Honeycomb Fabrication

Studies on fabrication of this material have been directed toward rolling, forming and joining of this material to enhance the plant capability in anticipation of future weapon projects.

Beryllium Fiber Metallurgy

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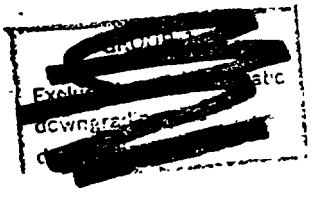

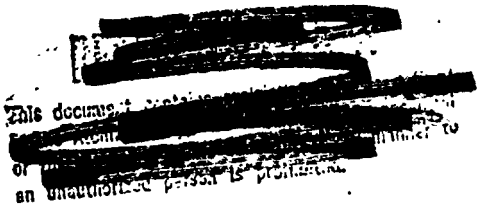

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Be Sheet

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SNAP-27 Program

The radioisotope generator of the SNAP-27 is designed to use beryllium for structural components. Y-12 has made tests of sheet beryllium materials and done welding studies relating to the fabrication of the beryllium body and fins for this generator.

Beryllium Extrusion

Efforts are also being directed at the multiple extrusion of beryllium rods (1/2 in.) canned in mild steel. Some work has also been accomplished on the extrusion of larger diameter rods.

Deleted

ROCKY FLATS

Beryllium Welding

Electron beam and tungsten-inert gas welding of beryllium tampers for pits. Welding studies are directed at all warhead pit designs and also insertion of Monel gas fill tubes. Welding studies are directed at achieving increased strength to contain higher pit pressures and eliminate or reduce shrinkage of metal at the waist joint.

Beryllium Bonding

Deleted

Be-Pu Bonding

Deleted

Be Evaporation

Study project to investigate use of a thick film of beryllium which could serve as a protective coating and eliminate corrosion of the base metal.

[redacted]

[redacted]

Wrought Be

Numerous studies on this material have been conducted relative to its utilization in weapons. Studies directed at increasing the strength of this material and promoting diffusion bonding are known to be in progress.

LRL

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Fabrication of strong hemishells with a good finish has been stressed and various diffusion, bonding studies have been directed at achieving a strong joint. Pressure, temperature, time studies have been coupled with varied diffusion or activation aids to investigate processes suitable for weapon production.

Deleted

Numerous welding studies have also been conducted at LRL employing electron beam and inert gas techniques to improve the joining of beryllium for numerous weapon allocations.

LASL

Deleted

No information on beryllium studies at LASL is currently available in DMA.

[redacted]